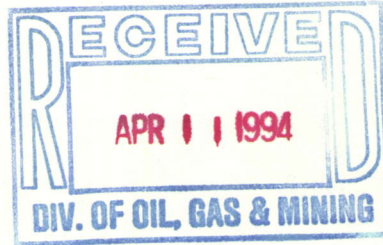


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Robert E. Dunne  
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**Kennecott**

April 5, 1994

Utah Department of Natural Resources Division of Oil, Gas, and Mining  
D. Wayne Hedberg  
355 West North Temple, 3 Triad Center, Suite 350  
Salt Lake City, UT 84180-1203

Dear Mr. Hedberg:

Subject: Design Basis - C-7 Ditch Relocation

This letter provides Kennecott Utah Copper Corporation (Kennecott) design basis for relocation of the C-7 Ditch as part of the Tailings Modernization Project (Project). As part of this modernization effort, tailings storage operations will be shifted from the existing impoundment to a North Expansion, a new impoundment to the north of the existing impoundment. This new impoundment will intercept several surface water drainage features in the area, requiring them to be relocated around the new impoundment. Corridors along the outward edge of the new impoundment will contain an access road, utilities, the relocated railroad right-of-way, and the relocated C-7 Ditch. This letter describes the design approach and criteria which will be used as the basis for relocating the C-7 Ditch.

The rerouted C-7 Ditch will intercept and convey overland flows coming from the watershed area and runoff conveyed by man-made channels. Total drainage area of the realigned C-7 Ditch at the historical Lee Creek outlet under Interstate 80 is about 80 square miles. This area excludes the interior portions of the existing impoundment and the North Expansion, since these structures will impound and store storm runoff. On the southwest side, the basin is bounded by the Oquirrh mountain range, which has several peaks that rise to more than 9,000 feet above MSL. In the foothills east of the mountains, the drainage area flattens, and consists of farmlands and developed residential and light industrial areas. Numerous roads, railroads, and canals are scattered throughout this valley and affect the local drainage patterns. To the east, the drainage area ends at about 3600 West. The drainage area will be delineated from USGS topographic maps (7.5-minute quadrangle maps) and divided into several subbasins.

The hydrologic computer analysis program *HEC-1*, developed by the U.S. Army Corps of Engineers (USACOE 1990a), will be used to develop hydrographs at subbasin outfalls. The hydraulic analysis will be conducted for the C-7 Ditch from the headwaters, which begin just south of 2400 South and just west of 8000 West, to the proposed outfall located at the historic Lee Creek crossing beneath Interstate 80. The hydraulic computer analysis

program *HEC-2*, developed by the USACOE (USACOE, 1990b), will be used to develop the water surface profiles of the C-7 Ditch.

The rainfall depths for the 100-year, 25-year, and 10-year, 3-hour storms will be estimated from Research Paper INT-274, *Precipitation Characteristics of Summer Storms at Straight Canyon Barometer Watershed, Utah* (USDA, 1981). An areal reduction factor of 85 percent (NOAA/USNWS, 1973) will be used to convert the point rainfall to areal rainfall. This distribution is considered reasonable based on local meteorological conditions and is acceptable to the Salt Lake County Flood Control District and Salt Lake City, based on reports prepared by CH2M Hill, (CH2M Hill, 1993a & b).

Rainfall excesses for each subbasin will be estimated using the U.S. Soil Conservation Service (SCS) runoff curve number (CN) method (McCuen, 1982; SCS, 1985). The CN values for each subbasin will be estimated based on the soil types, vegetative cover conditions, and land use conditions in each subbasin. The hydrologic soil groups within each subbasin will be identified from the SCS soil survey report for the Salt Lake area (SCS, 1974). The land use and vegetation cover conditions will be estimated from the soil survey report and topographic maps. Weighted CN values will then be computed for each subbasin under the antecedent moisture condition, AMC II. The AMC II condition is "the average degree of wetness of a watershed at the beginning of a storm" (SCS, 1985). This condition is generally used for design cases other than the PMP.

The flood hydrographs and peak discharges at various points along the new C-7 Ditch alignment will be computed using *HEC-1* (USACOE, 1990a). The assumptions made to derive the flood hydrographs and perform the flood routing are listed below:

1. Because the watershed area is approximately 79 square miles, a thunderstorm is not likely to cover the entire area at one time. Therefore, the area reduction factor allows the storm to be uniformly distributed over the entire 79 square miles of the drainage area (USNWS, 1973).
2. Based on field surveys and hydraulic analysis, the existing capacity of the Riter Canal is 250 cfs (CH2M Hill, 1993a). This flow will be input as a constant flow in the *HEC-1* hydrologic model.
3. The input hydrograph for the Brighton Drain will be a constant flow of 10 cfs as determined by CH2M Hill (CH2M Hill, 1993b). The 10 cfs is based on undeveloped land, poor channel conditions, and limited flow reaching the channel. Flow allowance for future development of West Salt Lake City will not be included.
4. All known stormwater detention features will be modeled as applicable.
5. Channel storage in the C-7 Ditch is considered and the flood hydrograph is routed through the ditch by providing the elevation-storage-discharge relations on various reaches of the ditch.
6. Existing subbasin master drainage studies will be evaluated. Hydrologic input will be incorporated into the analysis where applicable.

Synthetic unit hydrographs at each subbasin will be derived using the SCS dimensionless unit hydrograph approach (SCS, 1985). Major parameters for deriving a given unit hydrograph are the drainage area and the time lag. The time of concentration and corresponding time lag for each subbasin will be estimated using the SCS upland velocity method (McCuen, 1982; SCS, 1985). Based on the vegetative cover conditions and the slope of the ground surface along the longest flow path, the velocity within each segment will be obtained from the SCS velocity chart and the total travel time (time of concentration) will then be computed.

The flood hydrograph for each subbasin due to the rainfall storm will be computed using the derived unit hydrograph and the rainfall excess. The flood hydrograph at each of several different locations along the C-7 Ditch will then be obtained by routing and combining the flood hydrographs of the contributing subbasins from the upstream reach to the downstream point. Flood storage and routing techniques will be incorporated into the analysis where applicable. The Normal Depth method using the Manning formula (USACOE, 1990a) will be used to compute the elevation-storage and elevation-discharge curves.

Based on preliminary hydrology, it is anticipated that a 150-foot-wide corridor will be allocated for the C-7 Ditch from the point of diversion to the crossing beneath the interstate. The 150-foot corridor width is based on a 100-year, 3-hour design storm.

The U.S. Department of Agriculture has published two research papers, INT-110 (USDA, 1971) and INT-274 (USDA, 1981) which provide the design storm and precipitation patterns for the 100-year and 10-year, 3-hour storms, accepted by the Salt Lake County Flood Control District and Salt Lake City.

The C-7 Ditch channel will be designed to pass the maximum discharge resulting from the 10-year, 3-hour storm event with a minimum of 2 feet of freeboard. The channel will also be designed to pass the 100-year, 3-hour storm event with one foot of freeboard on the south berm and no freeboard on the north berm. For storms in excess of the 100-year, 3-hour event, flow would be allowed to overtop the north berm inundating the flood plain of the C-7 Ditch. Channel maximum side slopes will be 2:1 (horizontal to vertical).

Culverts passing below railways will be designed in accordance with the American Railway Engineering Association and Union Pacific Railroad requirements.

Drainage Culverts passing below Interstate-80 will be designed to safely pass the storm design criteria as set forth by the Utah Department of Transportation. If the design flow of the I-80 culverts is less than the 100-year, 3-hour storm flow, some ponding upstream of I-80 would occur. Controlled flooding within the railroad and Utah Power & Light (UP&L) corridors would be allowed in order to provide detention of flood flows. Increased headwater depth will facilitate flow through the existing culverts. High water levels of the Great Salt Lake will reduce the flow capacities of culverts under I-80, when the lake level exceeds the existing downstream invert elevations of the culverts. Lake levels in excess of 4206 (NAVD, 1988) will create outlet controls that reduce the flow capacity of the culverts.

Once the flow from the C-7 Ditch crosses Interstate 80, it enters the historic Lee Creek channel. The channel improvements will be designed to carry the 10-year, 3-hour storm


event with no freeboard. Larger flows would cause flooding of the adjacent flood plain north of Interstate 80. Channel improvements for larger flows would probably be useless, because potential inundation by high lake levels will cause new sediments to settle in the channel area. This typically has occurred during periods of high lake levels such as the mid 1980's.

At the other site roads, culverts will be designed to pass the maximum flow from a 25-year, 3-hour storm event without any static head and the 50-year, 3-hour storm without overtopping roads and drainage structures.

Channel erosion protection in the form of riprap will be required at least two culvert diameters upstream and four culvert diameters downstream of the culverts and at channel bends as needed.

If you have any questions concerning the design basis of the C-7 Ditch, contact me at 569-6675.

Yours very truly,



R. E. Dunne

PL/bsh

cc: P. R. Lorello  
File 12.400.410

Distributed to:

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Utah Dept. of Natural Resources, State Engineer (Robert L. Morgan)

UDOT (Kenneth H. Berg)

DOGM (D. Wayne Hedberg)

Salt Lake County Public Works (Neil Stack)

## SECTION 4 REFERENCES

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CH2M Hill, 1993b. *Westside Master Drainage Plan*. Report submitted to Salt Lake County, Utah, Department of Public Utilities.

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